POTENTIAL 2001 LANDING SITES IN MELAS CHASMA, MARS. C. M. Weitz[1], B. K. Lucchitta[2], and M. G. Chapman[2], [1]Jet Propulsion Laboratory, 4800 Oak Grove Drive, MS 183-335, Pasadena, CA 91109 (cweitz@jpl.nasa.gov); [1]U. S. Geological Survey, 2255 N. Gemini Dr., Flagstaff. AZ 86001.

Introduction: We have selected four areas in Valles Marineris as potential landing sites for the 2001 mission. After 20 years of analyses, the formation of the Valles Marineris system of troughs and its associated deposits still has not been sufficiently explained. They could have formed by collapse [1], as tectonic grabens [2], or in two stages involving ancestral collapse basins later cut by grabens [3,4]. Understanding all aspects of the Valles Marineris, in particular the interior layered deposits, would significantly contribute to deciphering the internal and external history of Mars. The deposits have been postulated to be remnants of wall rock [5], lacustrine deposits [6,7,8], mass wasting deposits [8,3], eolian deposits [9,7], carbonate deposits [10,11], or volcanic deposits [9, 12,13,14]. Because an understanding of the formation of Valles Marineris and its interior deposits is so important to deciphering the history of Mars, we have proposed landing sites for the 2001 mission on flat shelves of interior deposits in Melas Chasma (Figure 1).

Site Characteristics: The four sites we identified in Valles Marineris meet the current engineering criteria defined by the 2001 Project. All of these sites lie below 2.5 km in elevation and are at a pressure lower than 10.66 mbar. They are centered in southern Melas Chasma at approximately 11° S lat; the guided entry ellipse size is about 20 km in diameter at this latitude. An Earth-based delay-doppler-radar strip is located in Melas Chasma nearby. Surface slopes in each ellipse are less than 10°. There is less than 1% chance of landing on a rock greater than 31 cm high based upon the IRTM rock abundances, which show that all three sites are below 10% rock abundance. Viking images appear hazard free over the entire ellipse areas. In essence, the sites fit all of the engineering constraints and have the required 100 m/pixel or better resolution. However, the Viking images are poor in quality and therefore MOC coverage of the areas would be required to verify the sites are hazard-free.

Geology of the Sites: All four sites lie on a bench above the floor of Melas Chasma, which is a potential down-dropped fault block, surfaced with young (Amazonian) smooth floor deposits (likely eolian material) and rough landslide deposits [3,4,15]. The bench consists of eroded interior layered deposits (Late Hesperian to Early Amazonian in age) locally surfaced by a thin veneer of floor deposits (thin relative to that of the floor of Melas Chasma) [16]. Any encountered rocks would therefore likely be those of the interior layered deposits.

The interior deposits are the oldest unit of the Valles Marineris assemblage [15]. In Melas Chasma, they have a stratigraphic succession almost identical to that found in Candor and Ophir Chasma, which indicates that depositional processes forming individual interior units in the troughs were widespread and not local events [16]. Interior layered material is composed of layers of varying thickness and albedo. Where it is capped by resistant material it crops out as cliffs, but without this cap and within the ellipses the material weathers to smooth, flat lying surfaces. On the basis of horizontality, continuity, and layered aspect, the favored hypothesis has been that the deposits are of lacustrine origin [6,7,8,10,11], perhaps interbedded with air fall tuffs [12,15].

Ellipse A (Figure 1) is centered at lat 11.5° S, long 71.0°. The central part of the ellipse is mapped as smooth floor deposits on layered material, with remnant wall rock just to the northeast of the ellipse. Ellipse B is centered at lat 11.5° S, long 71.4° and has a similar geologic setting as ellipse A. An outcrop of wallrock material is located to the northwest, just outside of the ellipse. Ellipse C is centered at lat 11.6° S, long 72.1°. The central part of the ellipse is on smooth floor material with outcrops of light colored layers in scarps to the southwest and an exposure of remnant wallrock to the east. Finally, ellipse D is centered at 10.4°S, long 73.2° on smooth floor deposits. Outcrops of dark and light layers occur in scarps to the southwest.

Expected Results: The four sites we have selected in Melas Chasma would provide much needed insight into the interior layered deposits. Because of the likely possibility that water once existed in Valles Marineris and because the interior deposits may be of lacustrine or carbonate origin [6,7,8,10,11], analyses at one of the landing sites would have profound implications toward the climatic evolution of Mars. Exploration of Valles Marineris to search for fossil life forms would also be feasible given the likelihood for water and heat sources in the canyons [1,9,17]. If the deposits are determined to have a volcanic, perhaps silicic, origin, then analyses of the compositions would shed light on the volcanic history of Mars and have implications toward its tectonic and outgassing history.

The four sites will permit both the lander and rover to study rocks in-situ or derived from nearby scarps to determine the composition and origin of the interior layered deposits. One problem with the Pathfinder and Viking analyses of rock compositions was that the rocks' provenance was unknown. Hence, they could have been volcanic, impact, or sedimentary rocks from any number of sources. In contrast, at the four proposed sites rocks may be identified in outcrops. The rover may be able to use the APXS to analyze rocks from different layers in exposures, thereby determining the causes of light and dark banding in many of the interior

deposits. From this information, it should also be possible to determine the origin of the deposits and obtain important insights into the history of the Valles Marineris system. Color and spectral data from the lander PanCam and Mini-TES can also be used to analyze individual layers in exposures and rocks from nearby scarps. Atmospheric exploration could focus on hazes and clouds, which are occasionally observed in the troughs. In addition, landing in the Valles Marineris would not only yield valuable scientific returns, but would also provide spectacular scenery for the Earth-bound observer.

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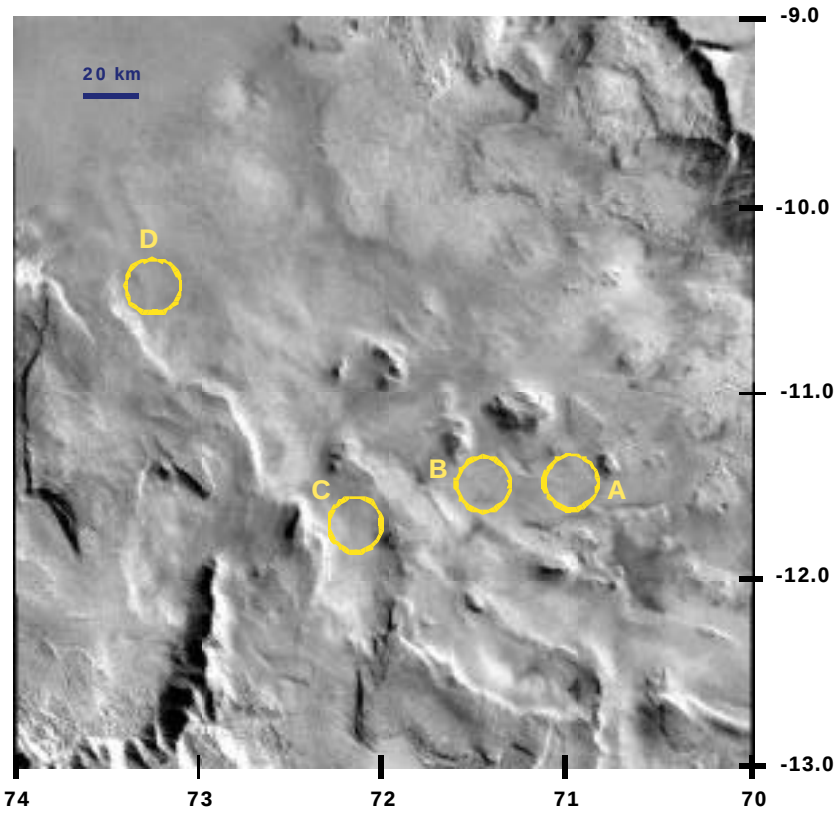

Figure 1. Proposed 2001 landing sites in Melas Chasma